IB SL Chemistry Summer Work Packet

IB SL Chemistry is an in-depth and rigorous (but hopefully enjoyable) course. This course will not only challenge you to advance your chemistry knowledge but also to develop your critical thinking, problem solving, and inquiry skills. The activities selected for summer work should help you review essential chemistry concepts, lay the foundation for the Internal Assessment component of this course, and allow us to hit the ground running in the fall. Completion of the following activities is required and will be due the ***first day*** of class.

Section 1: Things to Know

There is no "work" to be completed for this section. Instead, please find a list of commonly used items that you should review prior to the beginning of school.

1. **Element Names and Symbols**
2. **Common Polyatomic Ions, Polyatomic Elements, and Metal Ions**

   You need to know the names and formulas (including charge) of the following polyatomic ions.

Polyatomic Ions to Memorize

Negative Charge	Ion Name and Formula	
1-	hydroxide, OH^-	hypochlorite, ClO^-
	acetate, $C_2H_3O_2^-$	chlorite, ClO_2^-
	cyanide, CN^-	chlorate, ClO_3^-
	hydrogen carbonate, HCO_3^- (bicarbonate)	perchlorate, ClO_4^-
		hydrogen sulfate, HSO_4^- (bisulfate)
		nitrate, NO_3^-
		nitrite, NO_2^-
2-	chromate, CrO_4^{2-}	carbonate, CO_3^{2-}
	dichromate, $Cr_2O_7^{2-}$	sulfite, SO_3^{2-}
		sulfate, SO_4^{2-}
3-	phosphate ion, PO_4^{3-}	

Positive Charge	Ion Name and Formula
1+	ammonium ion, NH_4^{1+}

Polyatomic Elements to Memorize:

H_2, N_2, O_2, F_2, Cl_2, Br_2, I_2 P_4 S_8

Metal Ions to Memorize:

Ag^{+1} Zn^{2+} Cd^{2+} Al^{3+} Ga^{3+} Mercury (I) Hg_2^{+2} Mercury (II) Hg^{+2}

3. **Strong Acids and Bases**

   You need to know the names and formulas of the following strong acids and strong bases.

Strong Acids		Strong Bases
Hydrochloric Acid, HCl	Hydroiodic Acid, HI	Lithium Hydroxide, LiOH
Nitric Acid, HNO_3	Perchloric Acid, $HClO_4$	Sodium Hydroxide, NaOH
Sulfuric Acid, H_2SO_4	Chloric Acid, $HClO_3$	Potassium Hydroxide, KOH
Hydrobromic Acid, HBr		Barium Hydroxide, $Ba(OH)_2$

4. **SI Units and Conversions**

   You need to know all the SI units below and how to convert between magnitudes.

Property	Unit	Symbol
Mass	**gram**	**g**
Time	**second**	**s**
Temperature	**Kelvin**	**K**
Volume	**cubic meter**	**m^3**
Pressure	**Pascal**	**Pa**
Energy	**Joule**	**J**

TABLE 1.3 Selected Prefixes used in the Metric System

Prefix	Abbreviation	Meaning	Example
Giga	G	10^9	1 gigametre (Gm) = 1×10^9 m
Mega	M	10^6	1 megametre (Mm) = 1×10^6 m
Kilo	k	10^3	1 kilometre (km) = 1×10^3 m
Deci	d	10^{-1}	1 decimetre (dm) = 0.1 m
Centi	c	10^{-2}	1 centimetre (cm) = 0.01 m
Milli	m	10^{-3}	1 millimetre (mm) = 0.001 m
Micro	μ[a]	10^{-6}	1 micrometre (μm) = 1×10^{-6} m
Nano	n	10^{-9}	1 nanometre (nm) = 1×10^{-9} m
Pico	p	10^{-12}	1 picometre (pm) = 1×10^{-12} m
Femto	f	10^{-15}	1 femtometre (fm) = 1×10^{-15} m

[a]This is the Greek letter mu (pronounced 'mew').

Section 2: Chemistry Concept Review

Each of the following skills/concepts are essential to the IB SL Chemistry Course. Please take time to review and practice these concepts and skills. You may complete your work on this document (print or digitally) or show your work on a separate sheet of paper. You will submit these review problems on the ***first day*** of class. Video links are embedded if you need additional review/support.

1. Put the following into scientific notation and round the following quantities to the specified number of significant figures:

_____ **a.** 5,487,129 m to three significant figures

_____ **b.** 0.013479265 mL to six significant figures

_____ **c.** 31,947.972 cm^2 to four significant figures

_____ **d.** 192.6739 m^2 to five significant figures

_____ **e.** 786.9164 cm to two significant figures

_____ **f.** 389,277,600 J to six significant figures

_____ **g.** 225,834.762 cm^3 to seven significant figures

2. Make the following conversions. Put answer in correct number of sig. figs.

8.32 μm	= _____ dm	25 L	= _____ mL
2.194 cL	= _____ mL	1500 ps	= _____ ns
0.007 Mg	= _____ kg	0.00944 dm	= _____ km

3. Make the following conversions below.
   a. 32.0 g CH_4 to moles (2.00 moles)

   b. 8.76 g of NaOH to moles (0.219 moles)

   c. 27.00 moles H_2O to grams (486.5 g)

   d. 4.3 moles Ne to grams (87 g)

e. 0.78 moles Mg_2O_3 to formula units (4.70×10^{23})

f. 155 g NH_4OH to formula units (2.66×10^{24})

g. 4.78×10^{23} atoms Ag to moles (0.797 moles)

h. Determine the mass of one molecule of H_2O (3.0×10^{-23} g)

4. Calculate the average atomic mass for silicon if 92.21% of its atoms have a mass of 27.98 amu, 4.70% have a mass of 28.98 amu, and 3.09% have a mass of 29.97 amu. (28.09 amu)

5. Oxygen has three naturally occurring isotopes: O-16 with a mass of 15.99 amu; O-17 with a mass of 17.00 amu; and O-18. The relative abundances are 99.76%, 0.038%, and 0.20% respectively. What is the mass of O-18? (20.96 amu)

6. Complete the tables below.

	Symbol	Protons	Neutrons	Electrons
(a)	$^{134}Cs^{+}$			
(b)	$^{131}I^{-}$			
(c)		55	82	54
(d)		94	145	90

Element Name	**Symbol**	**Atomic number**	**Number Protons**	**Number Neutrons**	**Number Electrons**	**Mass Number**
Nitrogen						14
Sodium						24
	Br					80
		15				30
			27			60
	Ca					40
Argon						39
					56	138

7. A hydrogen filled balloon was ignited and 1.50 g of hydrogen reacted with 12.0 g of oxygen. How many grams of water vapor formed? (Show the balanced chemical equation).

8. Without doing any calculations, determine which of the sample contains the greatest number of the element in moles. Which contains the greatest mass of the element?
   a. 55.0 g Cr b. 45.0 g Ti c. 60.0 g Zn

9. What is the molar mass of methane (CH_4)?

10. How many hydrogen atoms are in 3.0 moles of ethanol, C_2H_5OH?

11. A compound with an empirical formula of CH_2 has a molecular mass of 42.09. What is its molecular formula?

12. A compound of nickel has a mass composition of 37.9% nickel, 20.7% sulfur, and 41.4% oxygen. What is its empirical formula?

13. Aluminum and iron(III) oxide react to form iron and aluminum oxide. What mass of iron is produced from the reaction of 21.4g of aluminum and 91.3g of iron(III) oxide? What is the limiting reactant? What is the excess reactant? (Show the balanced chemical equation).

14. What volume of nitrogen forms when 100. g of ammonia, NH_3, decomposes completely into its elements at STP? (Show the balanced chemical equation).

15. Calculate the volume in mL of 2.00 M HNO_3 solution required to react with 216 grams of Ag according to the equation.

$$3\ Ag(s) + 4\ HNO_3(aq) \rightarrow 3\ AgNO_3(aq) + NO(g) + 2\ H_2O(l)$$

16. Draw the Lewis structures for NH_3 and CO_2.

17. Name or write the chemical formula for the following:
    a. Sodium carbonate
    b. Sulfurous Acid
    c. Dinitrogen Trioxide
    d. Iron(III) oxide
    e. NH_4Cl
    f. $HClO_2$ (aq)
    g. SF_6
    h. $CuCl_2$

Helpful Videos

Scientific Notation: https://tinyurl.com/4cyzsrmt

Significant Figures: https://tinyurl.com/4yrys9bz

Conversions Video: https://tinyurl.com/4yrys9bz

Molar Conversions: https://tinyurl.com/4zknzbwk More Molar Conversion: https://tinyurl.com/yc3vy7ec

Average Atomic Mass: https://tinyurl.com/ytux9bd3 More Average Atomic Mass: https://tinyurl.com/ye288dnp

Empirical and Molecular Formula: https://tinyurl.com/46fmn9pr Emp. And Molecular Formula: https://tinyurl.com/jfue6bsr

Writing Balanced Chemical Equations: https://tinyurl.com/mpuc64wj

Stoichiometry: https://tinyurl.com/ywssry9h

Limiting vs. Excess Reactant: https://tinyurl.com/yc4wx37m

Lewis Structures: https://tinyurl.com/2p8pfk3u VSPER Theory: https://tinyurl.com/bdft3er3

Nomenclature: https://tinyurl.com/2p8says4

Section 3: Internal Assessment Preparation

In preparation for your Internal Assessment for Chemistry, you will complete a review of basic vocabulary and concepts that you need to be familiar with in order to make your IA a success. The following activity should be completed in a digital format (PowerPoint, Google Slides, Word Doc, etc). Include section designations by including the Part number and Part Title that are **BOLD** and **UNDERLINED** below. You will submit this along with Section 2 of the summer work to Schoology on the ***first day*** of school.

Part 1: General Vocabulary

Instructions: Define/describe the following terms. Include the terms.

1. Independent Variable
2. Increments
3. Dependent Variable
4. Control Variable
5. Uncertainty of Measurement with Example
6. Random Error
7. Systematic Error
8. Accuracy
9. Precision

Part 2: Graphing Basics

Instructions: Answer the following questions in complete sentences. Include the prompt or graph type.

1. When graphing data, explain what variable you should place on the x-axis and on the y-axis.
2. Explain what is meant by "properly labeling the axes" of a graph.
3. Explain how error bars are used and what they mean in terms of data shown.
4. Show an example (picture) and state what type of data is appropriately shown by the following graph types:
    A. Line graph
    B. Scatterplot with trendlines
    C. Circle (Pie) Graph
    D. Bar graph
    E. Double bar graphs
    F. Histogram
    G. Box and Whiskers plot

Part 3: Topics of Interest Research

*Instructions: Use the following questions to research **2** chemistry-related topics of interest you would like to investigate for your IA.*

There are PLENTY of websites available for you to get ideas from for this part of the assignment. Google "IB Chemistry IA Ideas" to start or check out youtube (Mr M 4 Chem is a channel worth checking out). Another good place to start is by looking through the IB SL Chemistry Syllabus. If there is a specific lab technique you would like to use (calorimetry, titration, colorimetry etc.), try to focus your topics of research on determining applications of this technique (think… what is the technique used for?). Be aware: there are some very common IA research questions out there. Use what you find as a starting point to build from. Part of your score is based on evidence of personal engagement with the topic and independent thinking.

1. Name of overarching concept: This is the BROAD topic (reactivity of metals, neutralization reactions, enthalpy of solution, enthalpy of reaction, reaction rates, etc).
2. Scientific explanation of concept—What is the concept? Give a definition and overview of the concept. Include citations for this information, if needed.
3. What about this topic would you like to investigate? Give a broad statement of your experiment that includes an independent and dependent variable--what would you be changing and what would you be measuring? (Suggestion: Think about what chemical mechanism/reaction is involved, what factors that could affect that reaction, and which factors you can easily manipulate (independent) and measure (dependent)). It is encouraged to choose an independent variable that can be varied continuously (e.g. temperature)
4. Give TWO citations of scientific studies that have done something like your idea in #3. Summarize each of the citations in one-two sentences.
5. Explain what you would like to do. This is the general procedure. If you found a link to an idea, you may include that here.
6. Personal interest—Why did you find this topic interesting? This should be YOUR OWN THOUGHTS and it should also include connection to BOTH A and B below:
    a. Application based on personal interest—Link your personal interest to the scientific concepts using citations.
    b. Application based on community/global interests—How does your topic apply to local community issues or global perspectives in chemistry?

If you have questions, please contact me at any time at alwelch@auburnschools.org . I will check my email weekly over the summer break and will be happy to assist you. However, please do not ask me to proof your ideas when completed before grading, as I will not do this. I WILL be happy to assist you on getting on the right track for the assignment.